Smart and Clean
Capital Markets Day 2006
Dré Schmitz, President Gas and Process Division
Driver for Smart and Clean
...is the growing demand for energy driven gas power station

Application fuel gas to the main gas turbine

Increase in Primary Gas Demand

Source: IEA World Energy Outlook 2004
Capital Markets Day – December 4, 2006

Distribution of Natural Gas

- Pipeline
- LNG carriers
- CNG carriers feasibility study short distance

LNG – Liquified Natural Gas

- Liquid form at atmospheric pressure and temperature –161 °C
- Reducing volume by a factor of 610

World LNG Potential

- The 12 countries that currently export LNG have approximately 28 percent of world natural gas reserves.
- Three countries with 33 percent of the world’s reserves are currently building their first liquefaction facilities.
- At least seven additional countries, with 19% of the world’s reserves, are potential LNG exporters.

- LNG fleet on the rise
- No of vessels
The LNG Value Chain

- Exploration & Development
- Production
- Transport
- LNG Transport
- Re-Liquification
- Distribution & Transport
- Marketing & Sell

Applications for Compressors

- Boil-off gas
  - 0.10 ~ 0.15% per day
- Propulsion
- Re-Liquification
- Steam Turbine
- Dual Fuel Engine
- Gas Turbine
- Slow Speed Diesel

Number of Compressors:

- 4
- 4
- 4-6 (*)
- 6

Traditional steam turbine powered LNG of 135 - 145 tm3 is virtually a thing of the past.

The majority of new ships currently being specified are:
- 210-217 tm3 with low speed diesel and on board re-liquefaction
- 150-180 tm3 with dual fuel diesel electric propulsion

Forecast 2006 - 2011:
- Steam: 19 vessels (14%) ➔ 76 compressors
- Dual fuel: 69 vessels (50%) ➔ 276 compressors
- Re-Liquefaction: 51 vessels (36%) ➔ 306 compressors
**LNG Equipment from Atlas Copco**

<table>
<thead>
<tr>
<th>XXL compressor, single-stage</th>
<th>Single Stage</th>
<th>Dual Stage</th>
<th>Tri-Stage</th>
<th>Diesel</th>
<th>Electric</th>
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<td>XXL compressor, multi-stage</td>
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<td>Nitrogen compressor</td>
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**Combined gas heater / vaporizer**

New Technology

**LNG – Reliquefaction**

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Size Comparison – HD Compressor

New technology

Size Comparison – LD – BOG 2 Stage

New technology

High Speed Direct Drive Compressor

New Technology

Advantages:
- Weight and space reduction
- Efficiency improvement
- No gear box required
- No lube oil system required
- Life cycle cost reduced
Example for Energy Recovery
Not for LNG

Process conditions GT098 L4K1
- Medium: Air
- Inlet pressure: 0.97 bar A
- Discharge pressure: 10.75 bar A
- Flow: 102,232 m³/hr
- Shaft power: 12,310 kW

Process conditions Twin ETI 450 NS
- Medium: N₂
- Inlet pressure: 8.00 bar A
- Discharge pressure: 1.35 bar A
- Flow: 41,000 Nm³/hr each
- Shaft power: 2,232 kW

Zandvliet – GT098 L4K1 + 2x ETI 450 NS

Gas and Process Division
Summary
- LNG demand is growing 8% per year
- The growth is driven by gas power stations
- We have developed the products together with our customers
- Technology can also be used for other applications
- The technology used contributes to a better environment and energy savings

We are committed to your superior productivity through interaction and innovation.